Performance Analysis of UDP/CBR &TCP/FTP Traffic Under Reactive and Proactive Routing Protocols in VANET

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Abstract-VANET is a growing technology which seeks the interest of many researchers as it uses high speed vehicles as mobile nodes to implement mobile ad-hoc network .There are different traffic pattern to generate Random Traffic for wireless scenario. Reliability and Capability of transmission of information are the important characteristics that are determined by traffic scenario, which is necessary for the performance analysis of VANET .In this paper TCP/FTP (Transmission Control Protocol/File Transmission Protocol) and UDP/CBR (User Datagram Protocol/Constant Bit Rate) traffic are used. The purpose of this paper is to analyze different traffic under reactive and proactive routing protocols in city scenario with varying node densities on the basis of Performance metrics i.e. packet delivery ratio, end to end delay and throughput .It is found that TCP/FTP offers a far better performance than UDP/CBR in case of Packet Delivery Ratio and Throughput for all routing protocols while the performance of UDP/CBR traffic is better in case of end to end delay for all routing protocols. In this paper Simulation has been done using discrete event simulator NS-2.35.

Keywords- Traffic pattern, TCP/FTP, UDP/CBR, Proactive and Reactive routing protocols, NS-2.35 , PDR, End to End delay, Throughput.

INTRODUCTION

In a city area, traffic congestion becomes severe problem nowadays & every year due to traffic accidents a significant number of fatal injuries and major property losses are reported. According to the WHO report Reviewed on May 2015, every year, 1.24 million people died as a result of crashes due to road traffic. Around 20 to 50 million people suffer non-fatal injuries, and as a result of their injury many meet with a disability. VANET (Vehicular ad-hoc Network) is an emerging technology, which helps to reduce road accident and congestion problem [1] . To provide safe and efficient routing of data in the network is one of the important challenges among several challenges in communication laid by VANET [5]. Hence, dynamic and efficient routing protocols need to be developed, which can guarantee efficient and secure routes of communication. Reliability and Capability of transmission of information are the important characteristics that are determined by traffic scenario, which is necessary for the performance analysis of VANET. The performance of routing protocols over different connections using Random Waypoint model is analyzed by researchers [3]. Main aim of this paper is to attain the performance evaluation of TCP/FTP and UDP/CBR traffic types under AODV ,DSR and DSDV Protocol, dealing with two variable parameters; simulation time and number or density of vehicles in city scenario. These scenarios are approved by simulations performed on Network Simulator-2 (NS-2.35) and the conclusions are drawn on the basis of performance metrics: packet delivery ratio, throughput, and average end to end delay.

The remaining description of this paper is systematically arranged as follows: Routing protocols for VANET are explained in Section II. Section III describes the performance metrics. Data Traffic types are explained in Section IV. Simulation environment is highlighted in section V. The simulation Models with their results are given in Section VI. The paper is finally concluded in section VII.

ROUTING PROTOCOLS

1.AODV

AODV is a reactive routing that uses routing tables, one entry per destination. To determine whether routing information is up-to-date and to avoid routing loops, sequence numbers are used. It helps in both multicasting and unicasting [4]. AODV employ RREQ & RREP message pair to discover the route. By broadcasting the RREQ message to its neighbors, the source node finds the route to destination [5]. The RREQ message contains fields; the source and destination address, lifespan of the message, a unique identification request ID and the source and destination sequence numbers. The Destination Sequence Number is the most recent sequence number received by the source from any route and the Source Sequence Number is the present sequence number to be used for route entry of the source node for the route request[4]. If from a list of neighbors any node recognizes the route to the destination then it can send RREP message to the source node.

2.DSR

DSR is also a reactive routing protocol. It discovers the route only on demand like AODV. Unlike AODV, DSR stores the complete path to the destination in its routing cache instead of the next hop node. The packet header field contains the address of all the intermediate nodes through which the packet moves to the destination node. This type of routing is known as source routing hence DSR name is so called. RREQ & RREP message pair is used to discover the route, like AODV. The Source node broadcasts the RREQ message and the node having a route to destination sends a RREP message [9]. An intermediate node rebroadcasts the RREQ message after adding its address to source address if it doesn't have information regarding destination node

3.DSDV

The Destination-Sequenced Distance-Vector (DSDV) Routing Protocol uses traditional Bellman-Ford Routing Algorithm in addition with some VANET related enhancements [6]. Every vehicular node manages a routing cache which lists the destinations with the number of vehicular nodes or no. of hops. To prevent the establishment of loops, sequence number is used to separate the old routes from new ones.

PERFORMANCE METRICS

VANET use a number of metrics for the evaluation of the performance of routing protocols in the network. In this paper the metrics considered to calculate the network performance are as follows:

1.Throughput: It is the total number of packets successfully delivered to destination during the simulation time. The unit used is kbps. The routing protocols with high throughput are more efficient.

$$Throughput = \frac{Received\ packets}{Elapsed\ Time} * (8/1000) \quad (1)$$

2.Packet Delivery Ratio: It is the number packets that are delivered to the destination. The
higher is the packe delivery ratio, the better is the routing protocol.

$$Packet\ Delivery\ Ratio = \frac{No.of\ packets\ recieved}{No.of\ sent\ packets} \quad (2)$$

3.End-To-End (E2E) Delay: The total time for transmitting a packet from source to the destination node is known as end to end delay. The delay performance metric includes the delays due to route discovery, packet propagation and sending time and the time of packet in queue.

$$E2E_{delay} = \frac{\sum(Recive\ time - Send\ time)}{Total\ data\ packets\ recieved} \quad (3)$$

DATA TRAFFIC /APPLICATION TRAFFIC TYPES

Network layer and Transport Layer have different types of Data and traffic agents respectively which is responsible to transport data in the network and provides different characteristics in the network [6,7,3]. The two different types of data/traffic agent namely TCP and UDP used in the network differentiated as depicted in Table I.

Table 1: Difference between TCP/FTP and UDP/CBR

Characteristics/ Description	TCP/FTP	UDP/CBR
General Description	TCP is a transport layer protocol which represents the data type and FTP is an application layer protocol which represents the application traffic agent which transports TCP data. In this type of scenario, communication occurs in three different phases, namely, connection establishment, data transmission, and connection termination	In this type of traffic scenario, UDP is a transport layer protocol which represents the data type and and CBR is an application layer protocol which represents the application traffic agent which transports UDP data.
Protocol connection Setup	Connection-oriented; Connection must be setup before Transmission.	Connection-less; In UDP, data is transmitted before establishing connection.
Data interface to application	Stream Based-. In Transmission control protocol, data is sent in the form of stream of bytes, and it does not preserve data boundary	Message base-packets can be send across the network in chunks. In UDP, Packets send indepen-dently and for integrity, they are is verified only if reached, UDP preserve data boundary
Reliability and Acknowledgements	Reliable delivery of message- TCP provides guaranteed delivery of data. If message is lost during transits then resending is done to recovered the lost message, which is controlled by TCP protocol itself, all data is acknowledged. Hence it offers bidirectional traffic.	Unreliable- UDP does not provide guaranteed delivery of data, hence said unreliable. A datagram may be lost during transit. No acknowledge -ment of data in case of UDP hence it offers uni-directional traffic
Ordering of data	Ordering of the message also guaranteed by	UDP doesn't provide guarantee of

	TCP means Delivery of Message will be in the same order as it was sent, though sequencing and ordering is done by TCP protocol itself on the receiving end as it may possibly that message will reach out of order.	ordering or sequencing. Datagram packets may arrive in any order.
Retransmissions	Delivery of all data is maintained, and lost data is resend automatically	Not performed
Features Provided to Manage Flow of Data	TCP has feature of Flow Control. Three packets is to be needed for establishing a socket connection prior sending of data. TCP taken care of congestion control	None
Overhead	Low, but higher than UDP	Very low
Transmission Speed	TCP is slower than UDP.	UDP is faster because it does not perform error-checking for packets.
Data quantity suitability	Small to very large amounts of data	Small to Moderate amounts of data

SIMULATION ENVIRONMENT

The simulation tool used in this paper is Network Simulator-2 (NS-2.35). NS-2 runs in both Windows and Linux. In this paper the operating system that is used to support the simulation described is window to run NS-2 in Windows, Cygwin is needed which works as a platform for NS-2. NS2 model representing the real network perfectly[7] The simulation of a VANET is done for TCP and UDP traffic types under reactive and proactive routing protocols in city scenario with varying node density on the basis of Performance metrics i.e. packet delivery ratio, end to end delay and throughput.

SIMULATION MODELS

In this paper, two simulation models have taken. These models stated three performance metrics for TCP/FTP and UDP/CBR connection environment for the two variable parameters.

1.Simulation Model 1: Varying Simulation Time

Table 2: Simulation Parameters for Model 1

Parameters	Transmission Protocol Type	
	TCP/FTP	UDP/CBR
Traffic Agent Type	FTP	CBR
Data Type	TCP	UDP
Channel	wireless	Wireless
Network Size	700 m*700 m	700 m*700 m
Number of nodes	20	20
Max. no. of connections	50	50
Speed of Vehicles	10-40 km/h	10-40 km/h
Simulation time	200, 400, 600, 800, 1000 sec	
Routing Protocols	AODV, DSR, DSDV	
Scenario	City scenario	
Turning probability	0.5	
Speed change probability	0.5	
Performance	Packet Delivery Ratio, End to	

Metrics	End Delay, Average Throughput
Interface Queue Type	Priority Queue (50 Packets)
Antenna Model	Omni-directional Antenna
Radio Propagation Model	Two-Ray Ground
MAC Type	IEEE 802.11
Simulator	NS-2.35

1.1 Result 1: Packet delivery ratio vs. Simulation Time

Considering all three protocols for Packet Delivery Ratio, it is found that TCP performs much better than UDP in case of AODV and DSDV while both performs almost same in case of DSR. This is shown in Figures 1, 2 & 3.

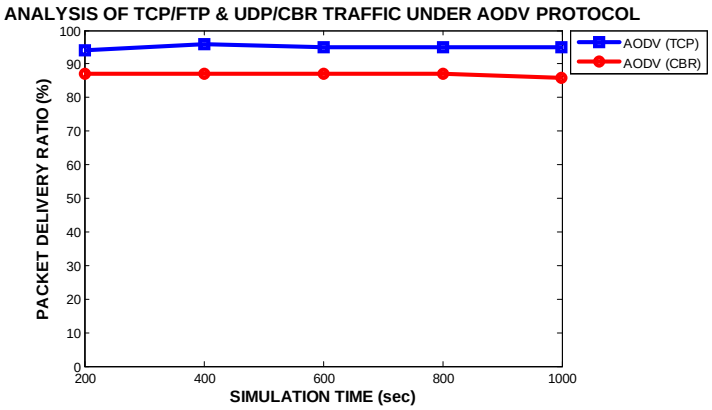

Figure-1: Performance Analysis of TCP and UDP considering Packet Delivery Ratio in case of AODV Protocol

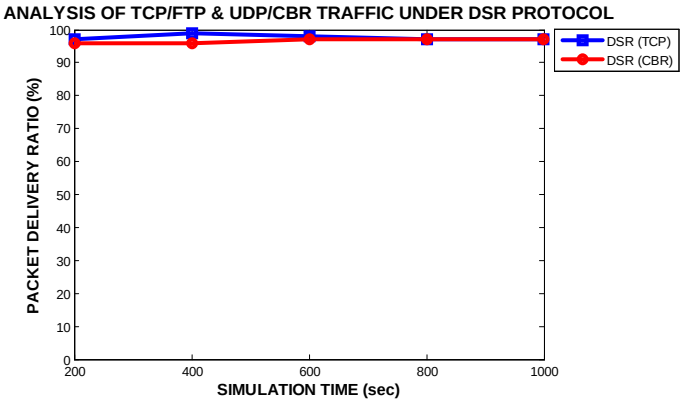

Figure-2: Performance Analysis of TCP and UDP considering Packet Delivery Ratio in case of DSR Protocol

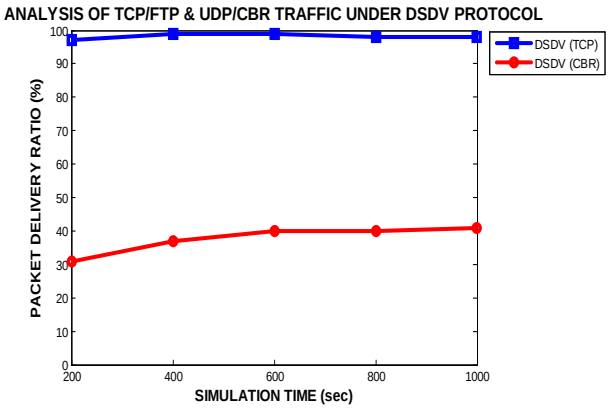

Figure-3: Performance Analysis of TCP and UDP considering Packet Delivery Ratio in case of DSDV Protocol

1.2 Result 2: Throughput vs. Simulation Time

Considering throughput as performance metrics, performance of TCP traffic is superior than UDP traffic under all three protocols. This is shown in Figures 4, 5 & 6.

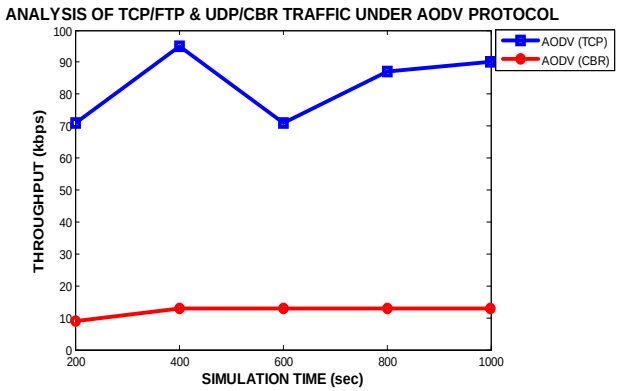

Figure-4 :Performance Analysis of TCP and UDP considering Throughput in case of AODV Protocol

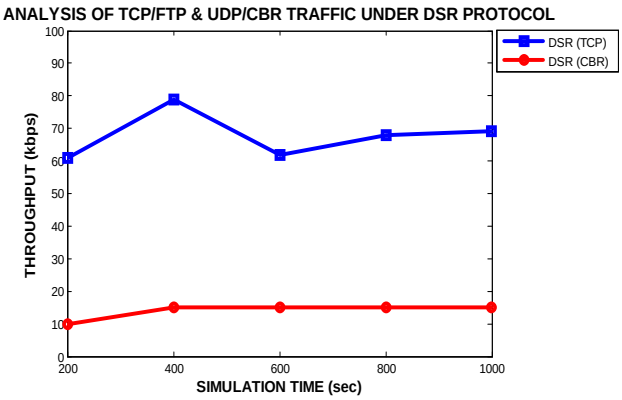

Figure-5: Performance Analysis of TCP and UDP considering Throughput in case of DSR Protocol

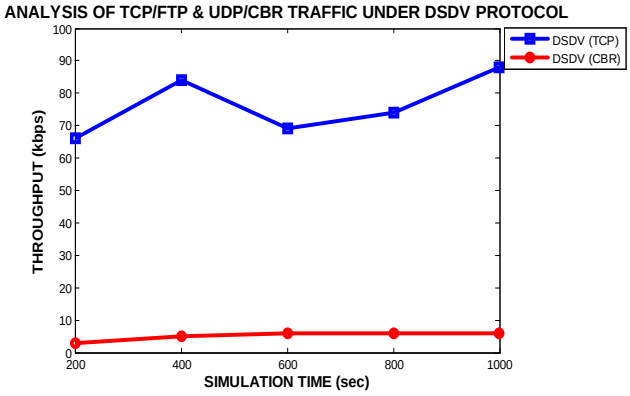

Figure-6: Performance Analysis of TCP and UDP considering Throughput in case of DSDV Protocol

1.3 Result3: End to End DelayvsSimulation Time

UDP is better in case of End to End Delay under all three protocols . This is shown in Figures 7, 8 & 9.

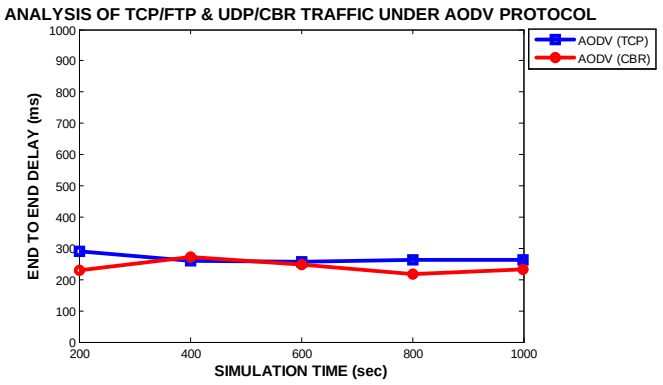

Figure-7: Performance Analysis of TCP and UDP considering End to End Delay in case of AODV Protocol

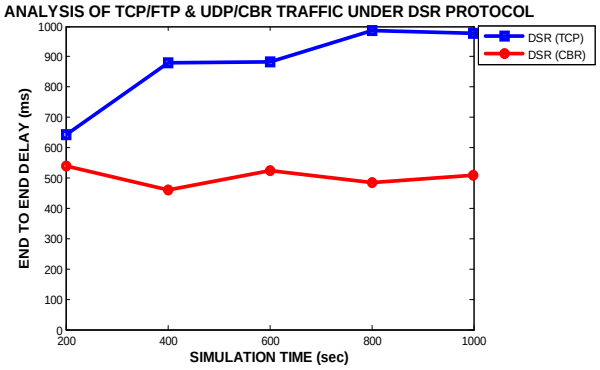

Figure-8: Performance Analysis of TCP and UDP considering End to End Delay in case of DSR Protocol

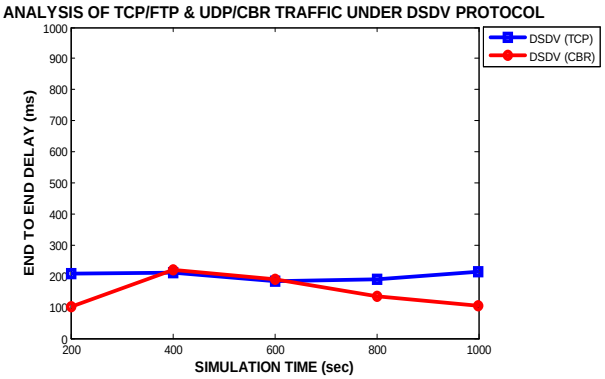

Figure-9: Performance Analysis of TCP and UDP considering End to End Delay in case of DSDV Protocol

2.Simulation Model 2: with Varying Number of Vehicles/Different Vehicle Density

Table 3: Simulation Parameters for Model 2

Parameters	Transmission Protocol Type	
	TCP/FTP	UDP/CBR
Traffic Agent Type	FTP	CBR
Data Type	TCP	UDP
Channel	wireless	Wireless
Network Size	700 m*700 m	700 m*700 m
Number of nodes	20,40,60, 80,100	20,40,60,80,100
Max. no. of connections	50,100,150,200,250 respectively	50,100,150,200,250 respectively
Speed of Vehicles	10-40 km/h	10-40 km/h
Simulation time	1000 sec	
Routing Protocols	AODV, DSR, DSDV	
Scenario	City scenario	
Turning probability	0.5	
Speed change probability	0.5	
Performance Metrics	Packet Delivery Ratio, End to End Delay, Average Throughput	
Interface Queue Type	Priority Queue (50 Packets)	
Antenna Model	Omni-directional Antenna	
Radio Propagation Model	Two-Ray Ground	
MAC Type	IEEE 802.11	
Simulator	NS-2.35	

2.1 Result 1: Packet Delivery Ratio vs. Number of Vehicles

Taking PDR as performance metrics for comparison of traffic types, it is found that TCP is better as well as stable under all three routing protocols. This is shown in Figures 10, 11 & 12.

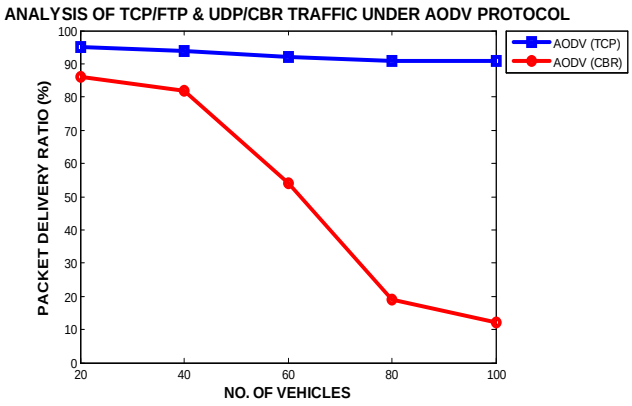

Figure-10: Performance Analysis of TCP and UDP considering Packet Delivery Ratio in case of AODV Protocol

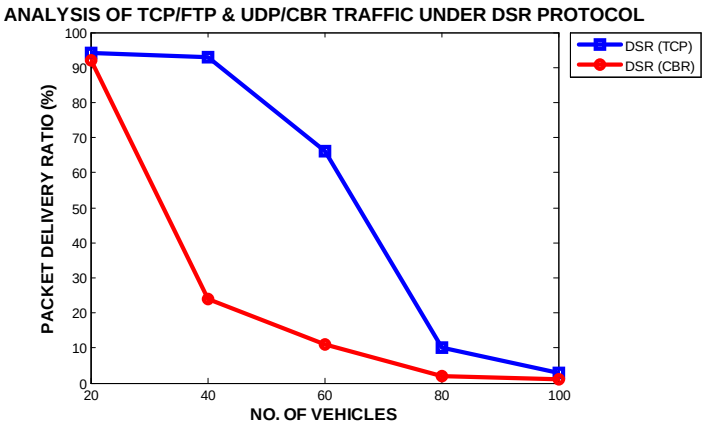

Figure-11: Performance Analysis of TCP and UDP considering Packet Delivery Ratio in case of DSR Protocol

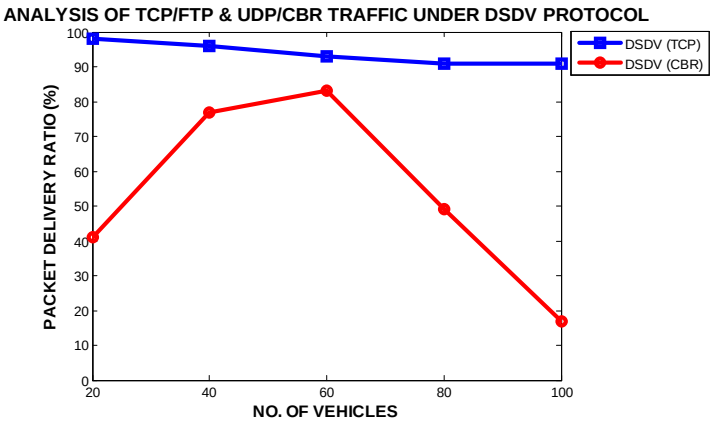

Figure-12: Performance Analysis of TCP and UDP considering Packet Delivery Ratio in case of DSDV Protocol

2.2 Result 2: Throughput vs. No. of Vehicles

Considering Throughput as performance metrics for analysing traffic type,under AODV and DSDV Protocol performance of TCP is better than UDP while under DSR TCP performs better for less no. of vehicles and as no. vehicles increases the performance of TCP decreases and becomes equal to UDP.

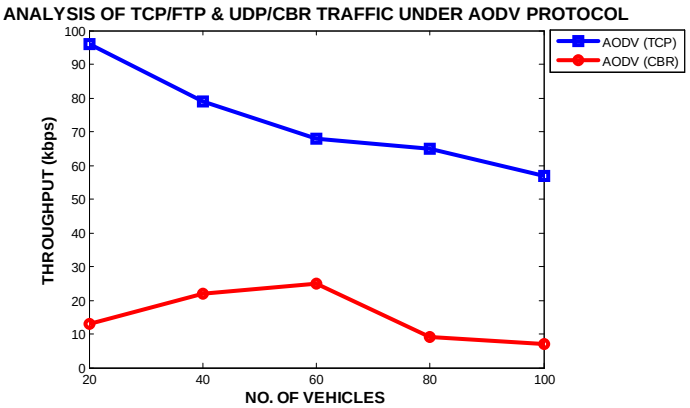

Figure-13: Performance Analysis of TCP and UDP considering Throughput in case of AODV Protocol

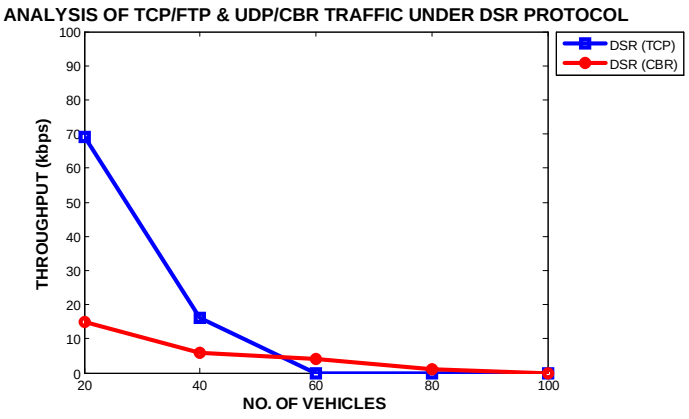

Figure-14: Performance Analysis of TCP and UDP considering Throughput in case of DSR Protocol

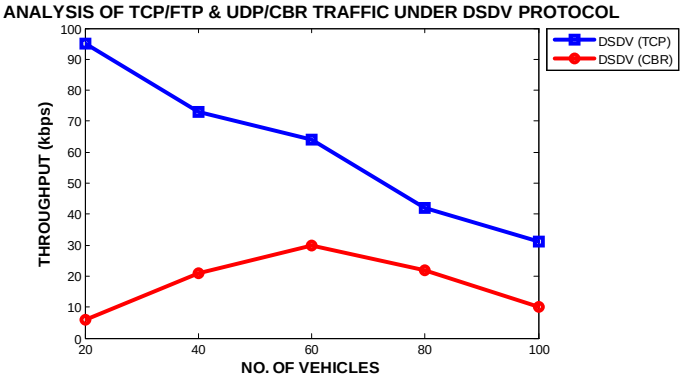

Figure-15: Performance Analysis of TCP and UDP considering Throughput in case of DSDV Protocol

2.3 Result 3: End to End Delay vs. Number of Vehicles

Considering End to End Delay as performance metrics, under AODV and DSDV routing protocols UDP is better for less vehicle while as no. of vehicles increases in a network TCP performs better, and under DSR routing protocol UDP is superior even for increasing no. of vehicles.

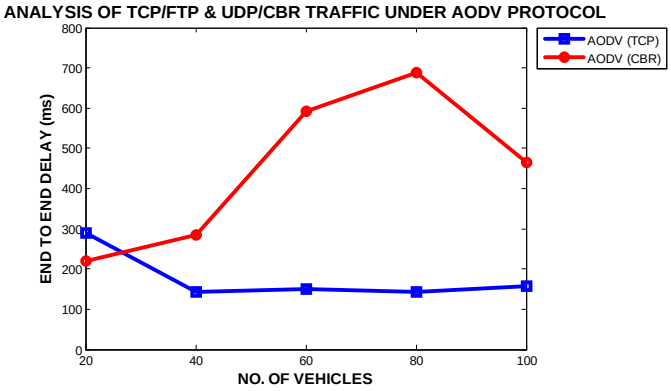

Figure-16: Performance Analysis of TCP and UDP considering End to End Delay in case of AODV Protocol

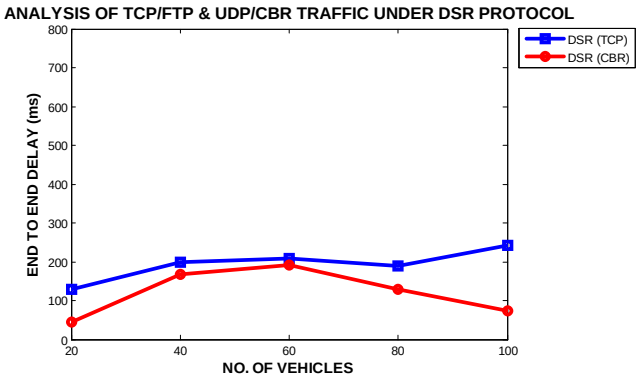

Figure-17: Performance Analysis of TCP and UDP considering End to End Delay in case of DSR Protocol

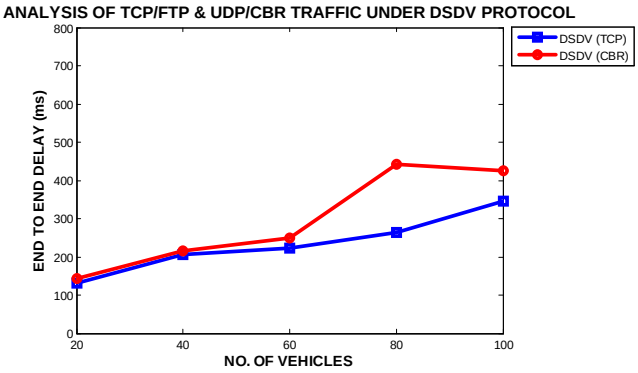

Figure-18: Performance Analysis of TCP and UDP considering End to End Delay in case of DSDV Protocol

CONCLUSION

In this paper, the two traffic scenarios are compared i.e. TCP/FTP and UDP/CBR. To find the appropriate traffic type from these two available different traffics types in a network in city scenario, essential conclusions are prepared by examining the results and finally this paper is concluded by comparing two different traffic patterns via three performance metrics i.e. Throughput, Packet Delivery Ratio (PDR), End to End Delay. Number of conclusions drawn from number of experiments, observations, and analysis are as follows:

1.Packet Delivery Ratio (PDR): For Varying Simulation Time. of vehicles and no, out of the two traffic types i.e. TCP/FTP provides far better performance than the UDP/CBR. TCP/FTP is stable as well. This proves that the network working with routing protocols is more reliable.

2.Throughput: For Varying Simulation Time, TCP/FTP provides superior performance than the UDP/CBR but not stable While for varying no. vehicles TCP/FTP is better as well as stable. This proves that the network working with routing protocols provides improved efficiency with TCP/FTP than UDP/CBR.

3.End to End Delay: For Varying Simulation Time, UDP/CBR offers lesser end to end delay than TCP/FTP, therefore speed of transmission is high in case of UDP, but for the scenario with Varying no. of vehicles , as the density of vehicles increases, the End to End delay of TCP/FTP decreases and becomes lesser than UDP/CBR under AODV and DSDV protocols but for DSR protocol UDP/CBR offers lesser end to end delay than TCP/FTP . For future extensions in this work, the concept can be used with various variations of TCP to give a extensive performance analysis for various routing protocols and performance metrics.

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